2006 AMMA Cruise Summary

AEROSE-II Piggyback Mission

Trans-Atlantic Aerosol and Ocean Science Expedition

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AIRS Science Team Meeting
Beltsville, MD
28 September 2006

With special thanks to…

- B. Molinari, R. Lumpkin and C. Schmid (NOAA/AOML)
- R. Knuteson and W. Feltz (UW/CIMSS)
- G. Jenkins, M. Hawkins, L. Roldán, A. Flores, and T. Creekmore (HU/NCAS)
- M. Szczodrak, M. Izaguirre, K. Voss and E. Key (UM/RSMAS)
- P. Clemente-Colón and C. Barnet, (NESDIS/STAR)
- W. Wolf and C. Dean (QSS Group, Inc.)

AEROSE Overview

- The **Aerosol and Ocean Science Expeditions (AEROSE)** are a series of trans-Atlantic intensive field campaigns conducted aboard the NOAA Ship *Ronald H. Brown (RHB).*
  - AEROSE-I (NH Spring 2004)
  - AMMA-AEROSE-II (NH Summer 2006)
- The ongoing AEROSE mission focuses on providing a set of complementary measurements that characterize the impacts and microphysical evolution of aerosols from the African continent during their transport across the Atlantic Ocean.
- A comprehensive suite of aerosol measurements and size-segregated sampling is performed during each cruise to characterize the evolution of aerosol mass distributions.

AEROSE Goals

The three central scientific questions being addressed by AEROSE are

1. What is the extent of change in the mineral dust and smoke aerosol distributions as they evolve physically and chemically during trans-Atlantic transport?

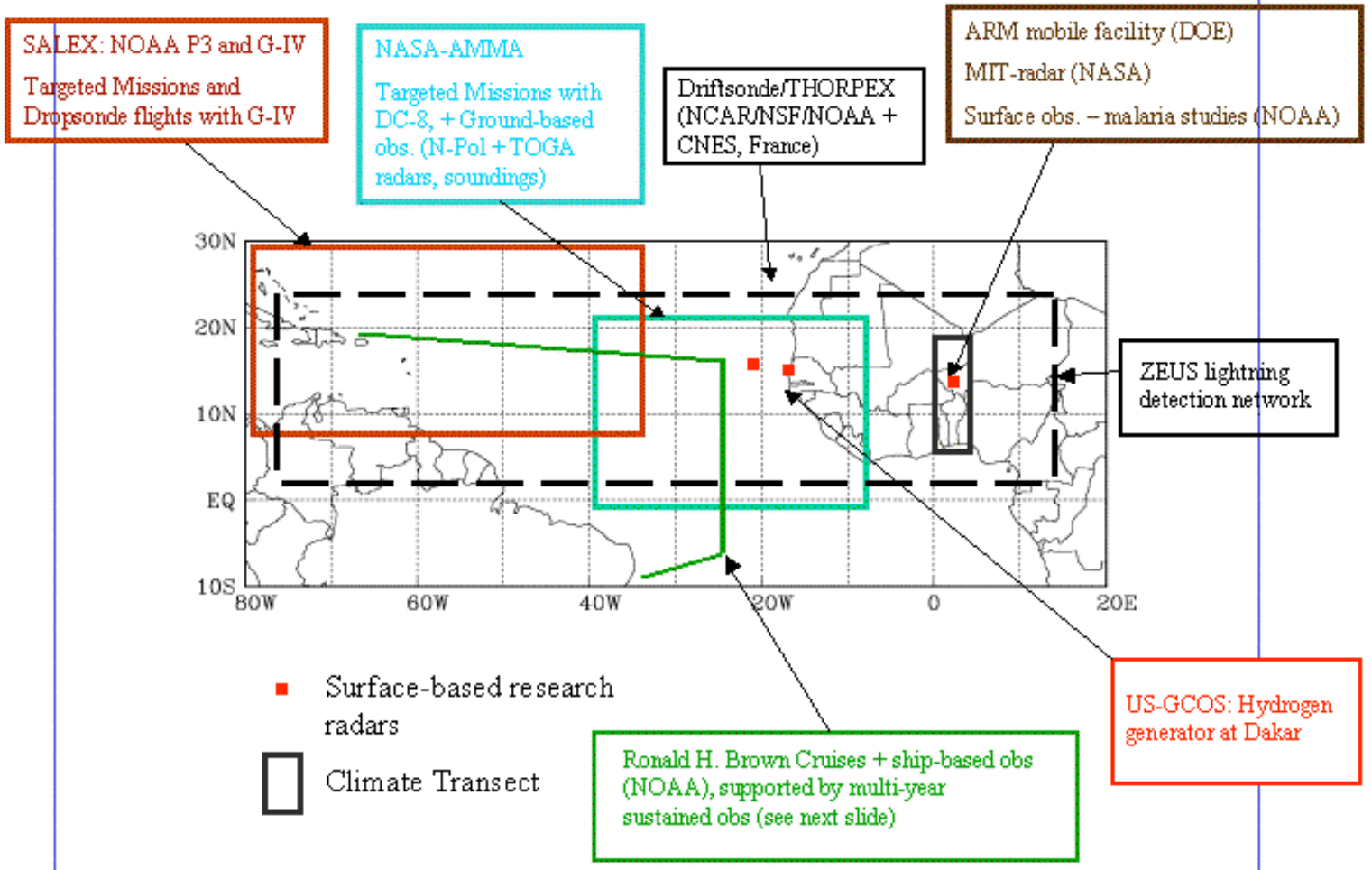
2. How do Saharan and sub-Saharan aerosols affect the regional atmosphere and ocean during trans-Atlantic transport?

3. What is the capability of satellite remote sensing and numerical models for resolving and studying the above processes?

AMMA-AEROSE-II Cruise Snapshot

- Piggyback sub-mission on a PIRATA (Pilot Research Array Tropical Atlantic) buoy deployment cruise conducted as part of the international **African Multidisciplinary Monsoon Analyses (AMMA)**
- NOAA/AOML allocated ship time for 54 days during Jun-Jul 2006. The primary objective of the main mission was to drop 2 TAO moorings to expand the Atlantic PIRATA moored array.
- The AMMA Cruise consisted of 2 nearly identical legs over an 8-week period:
  - **Leg 1:** Departed San Juan, Puerto Rico on 27-May. Proceeded across the Atlantic to a waypoint at 20°N, 23°W. The 2 TAO moorings were dropped along 23°W longitude while proceeding southbound. After reaching a 2nd waypoint at 5°S, then made way for the South American coast for a port call in Racife, Brazil on 18-Jun.
  - **Leg 2:** Departed Recife on 22-Jun proceeding along a similar route, with the exception that the ship returned to her home port in Charleston, SC on 16-Jul.

US contributions to AMMA field program in 06



Participating Institutions

- **Howard University NOAA Center for Atmospheric Sciences (HU/NCAS)**
- **NOAA/NESDIS/STAR; QSS Group, Inc.**
- **University of Miami/RSMAS**
- University of Wisconsin-Madison/CIMSS
- NOAA/OAR Atlantic Oceanographic and Meteorological Laboratory (AOML)
- NOAA Pacific Marine Environmental Laboratory (PMEL)
- NOAA/OAR/ESRL/PSD (formerly NOAA/ETL)
- NOAA/NWS/NCEP

Key Onboard Collaborators

NAME	INSTITUTION	RESPONSIBILITY
R. Lumpkin C. Schmid	NOAA/AOML	Co-Chief Scientists; TAO Moorings; CTD, XBTs
V. Morris E. Joseph Grad Students	HU/NCAS	Aerosols; Chemistry; Radiation Budget; Ozonesondes; Chief Scientist – Leg 2b
N. Nalli	QSS Group, Inc. NOAA/NESDIS/STAR	Sondes; AIRS Validation; IR Remote Sensing
M. Szczodrak M. Izaguirre	UM/RSMAS	M-AERI Observations; Micropulse Lidar; MW Radiometer; All-sky camera

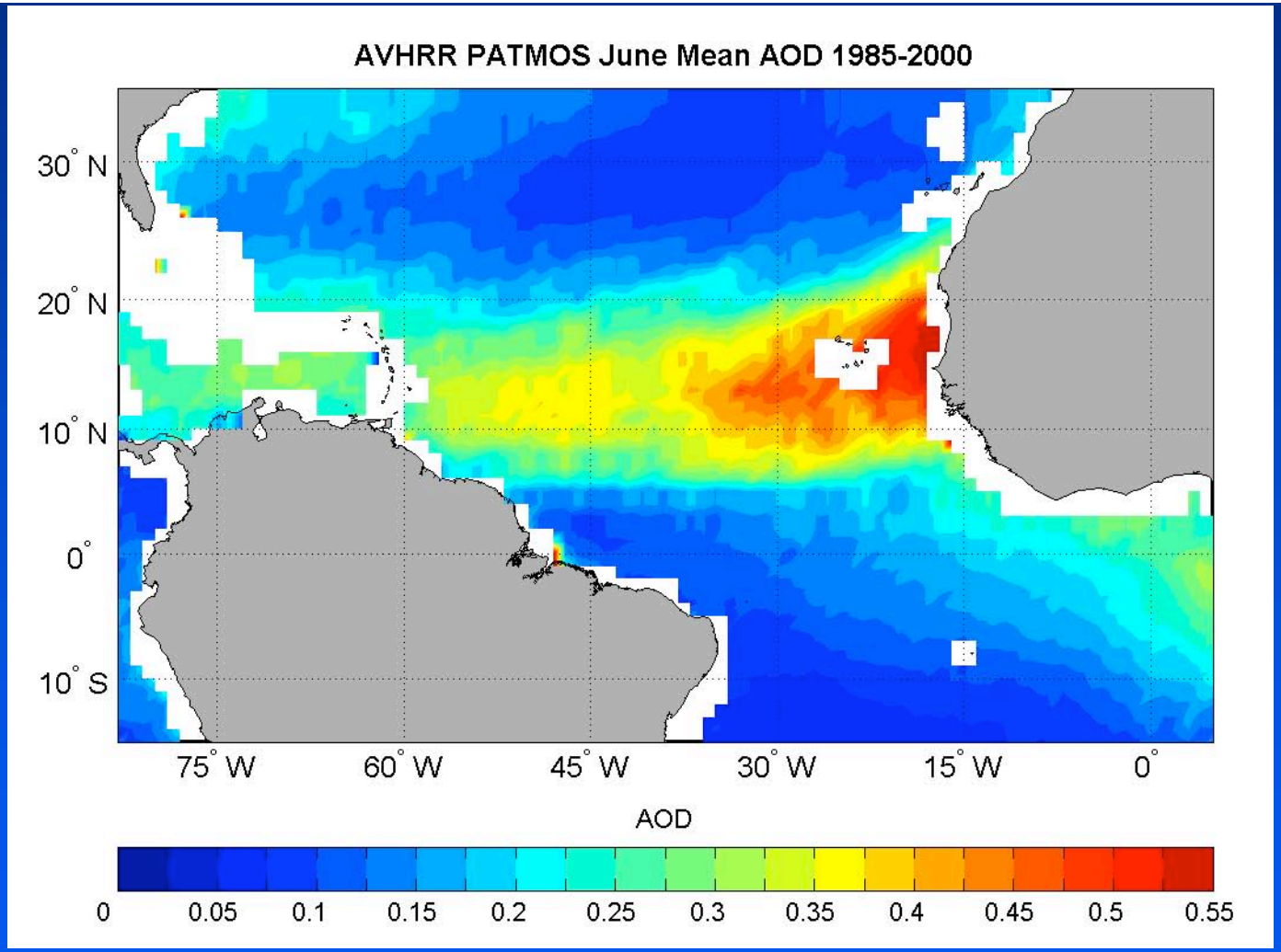
Key Shoreside Collaborators

NAME	INSTITUTION	COLLABORATION
B. Molinari	NOAA/AOML	Chief Scientist, AMMA Team PI
G. Jenkins	HU/NCAS	Forecast support, N-AMMA Team Member, ozonesondes
M. Goldberg C. Barnet J. Wei E. Maddy W. Wolf	NOAA/NESDIS/STAR QSS Group, Inc.	AIRS Data and Retrievals
P. Minnett K. Voss	UM/RSMAS	M-AERI Data; All-sky camera Micropulse Lidar
C. Fairall D. Wolfe	NOAA/OAR/ESRL/PSD (formerly NOAA/ETL)	Vaisala sounding system; Surface Flux Measurements; C-Band Radar; Wind Profiler; Sea Space Satellite Uplink
S. DeSouza-Machado L. Strow	UMBC	AIRS/M-AERI Radiative Transfer Modelling
R. Knuteson W. Feltz	UW-Madison/CIMSS	ARM CART AERI – Niger; RS-92 sonde funding

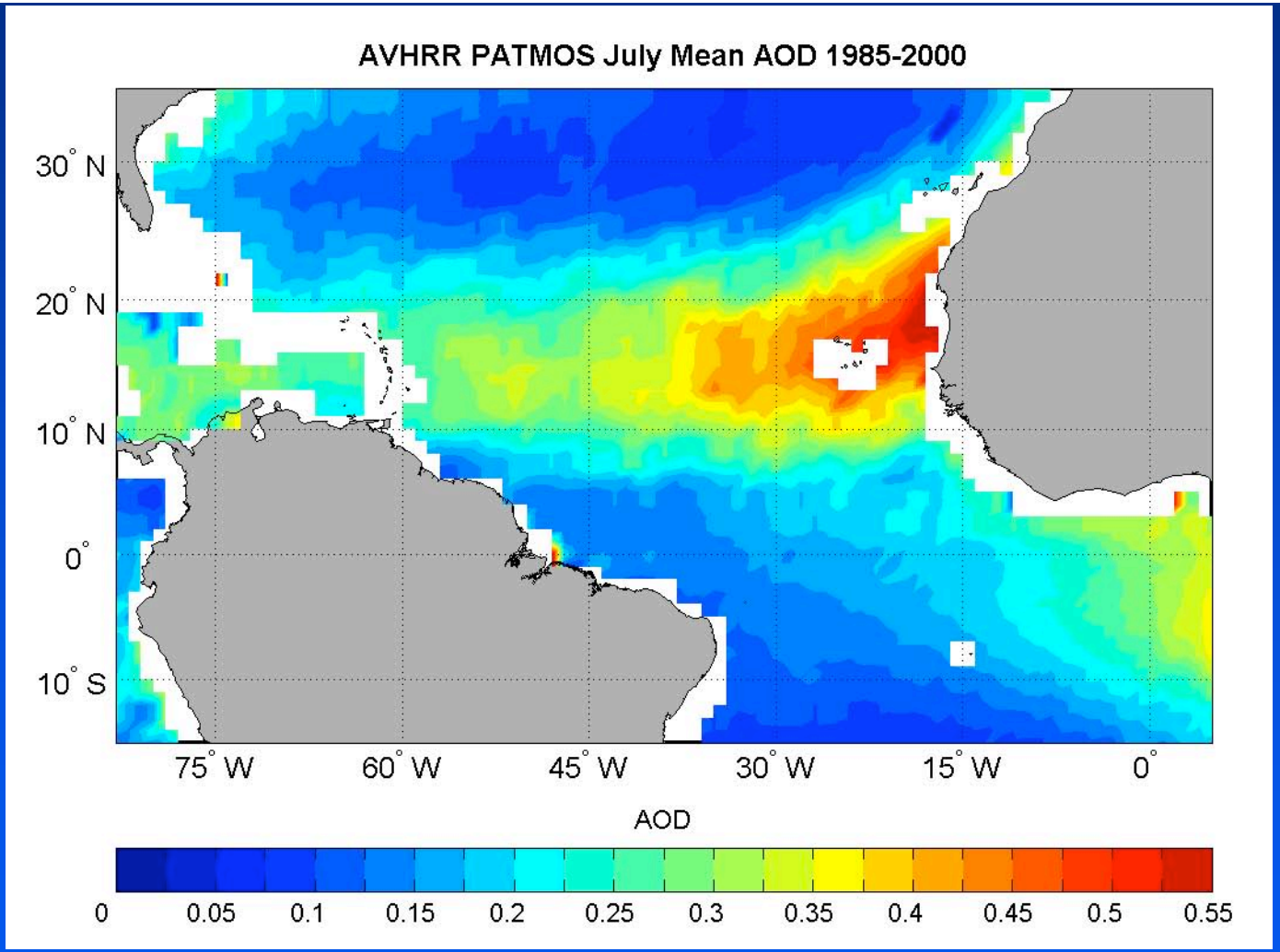
Instrumentation/Measurements

- Micropulse Lidar (MPL)
- Microtops sun photometer
- Vaisala RS92 Radiosondes
- SciPump ECC-6A Ozonesondes
- M-AERI
- Cascade impactors
- PM10 high volume sampler
- Laser particle counter
- CTDs, XBTs
- MFRSR (shadowband radiometer)
- Microwave radiometer (integrated water)
- Broadband pyronometer
- *In situ* trace gases: O_3, CO, SO_2, NO_x
- Surface meteorological & oceanographic measurements

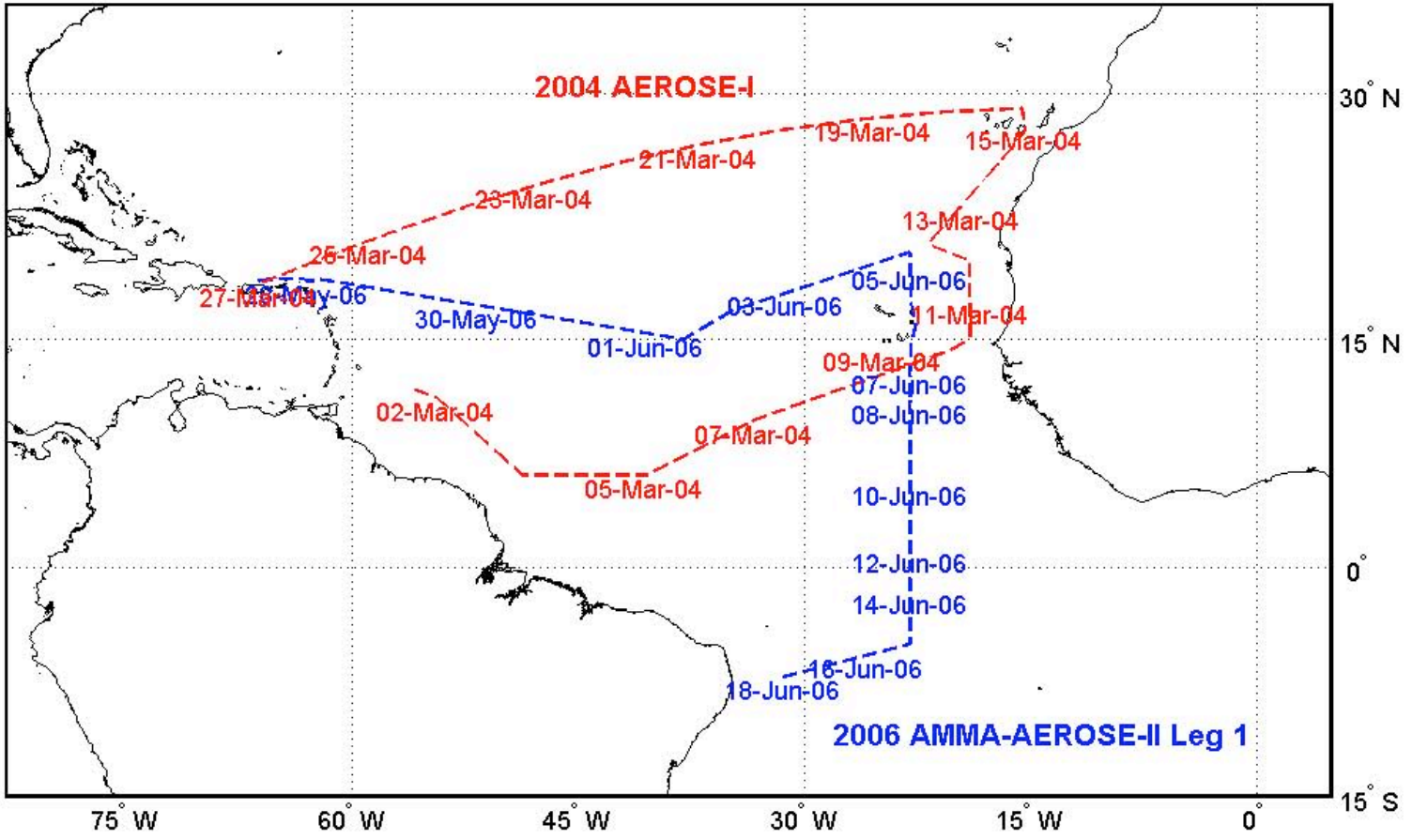
Satellite Aerosol Climatology – June



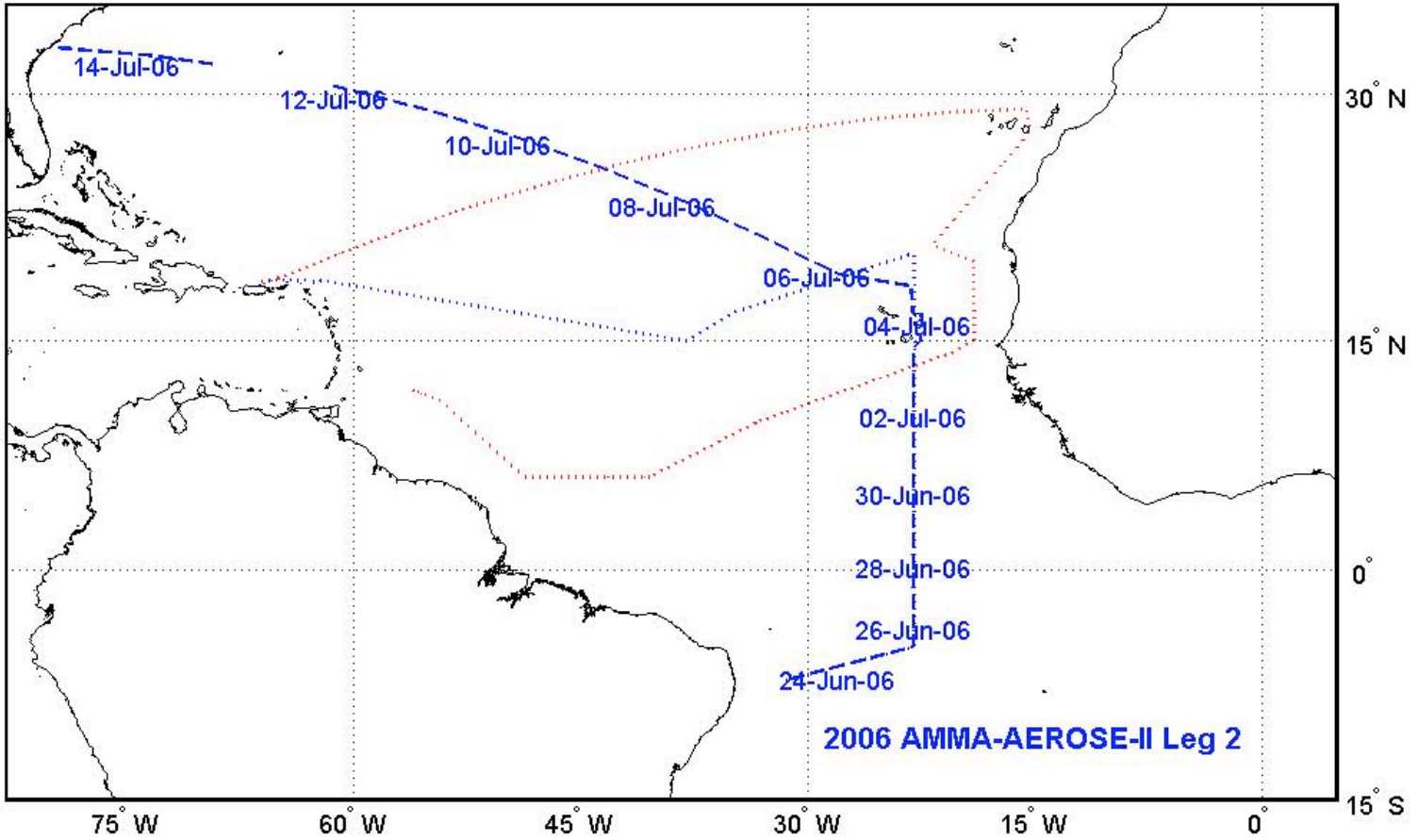
Satellite Aerosol Climatology – July



AEROSE Cruise Tracks to Date

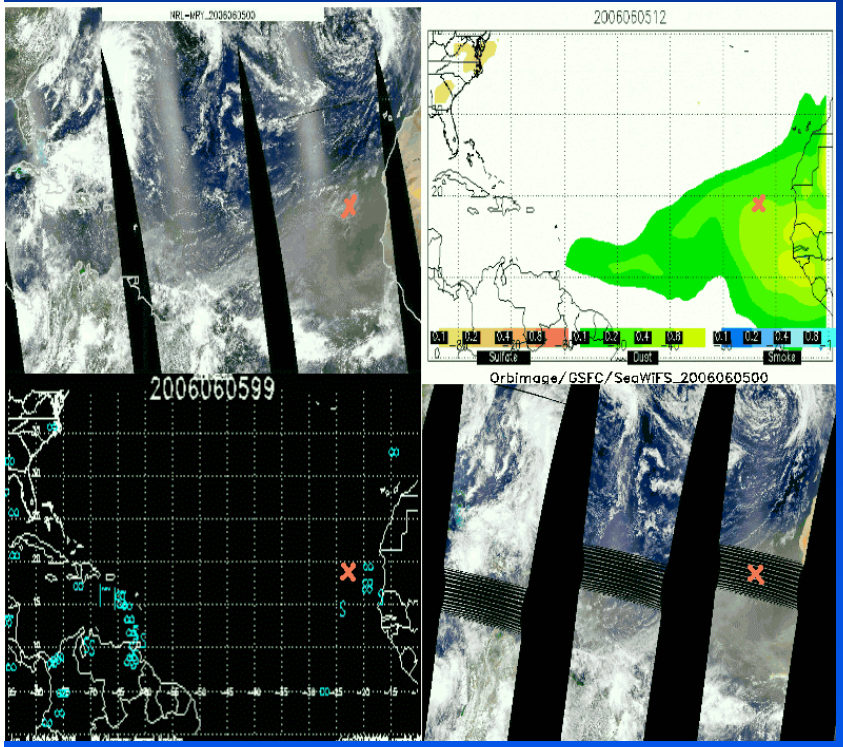


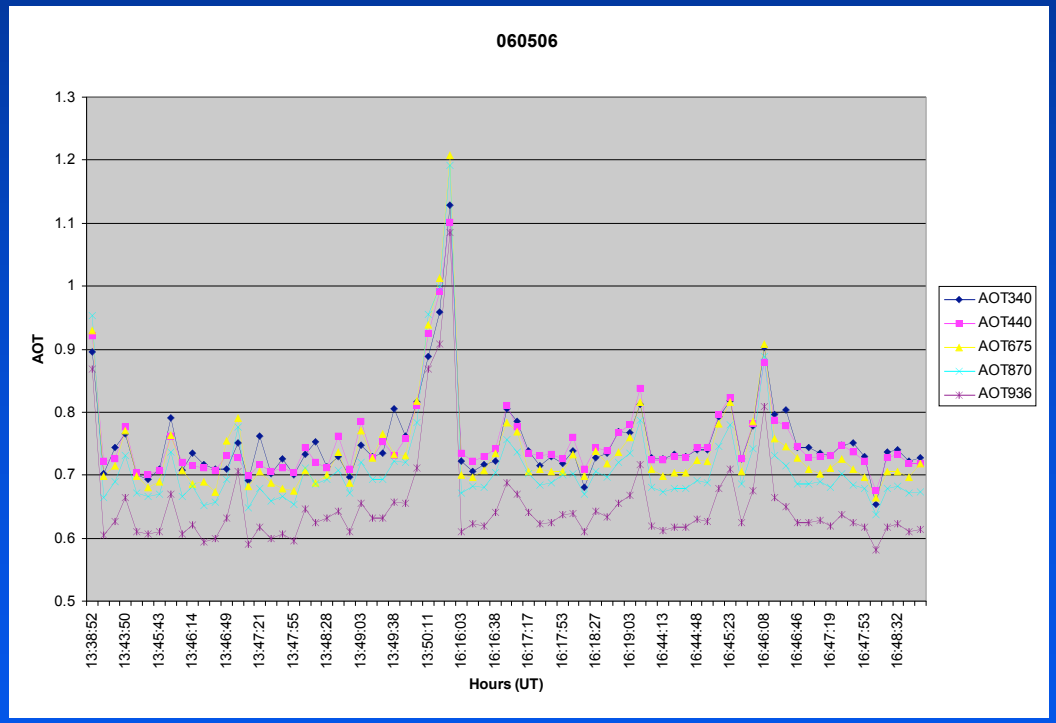
AEROSE Cruise Tracks to Date



Satellite, NAAPS, and Microtops Aerosols During AEROSE-II Leg 1
5 June 2006 12:00 UTC

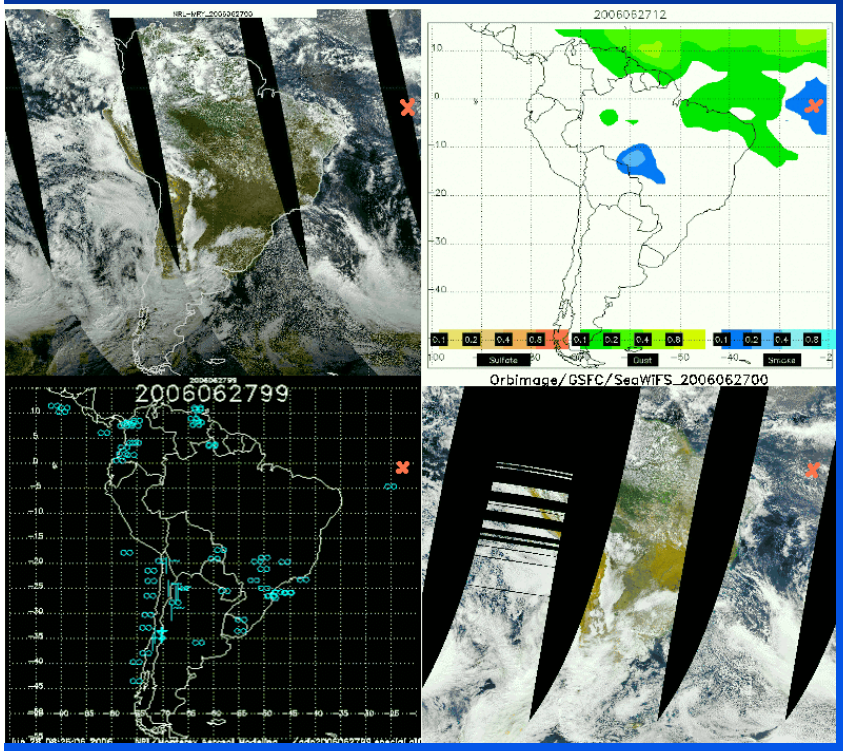
Dust

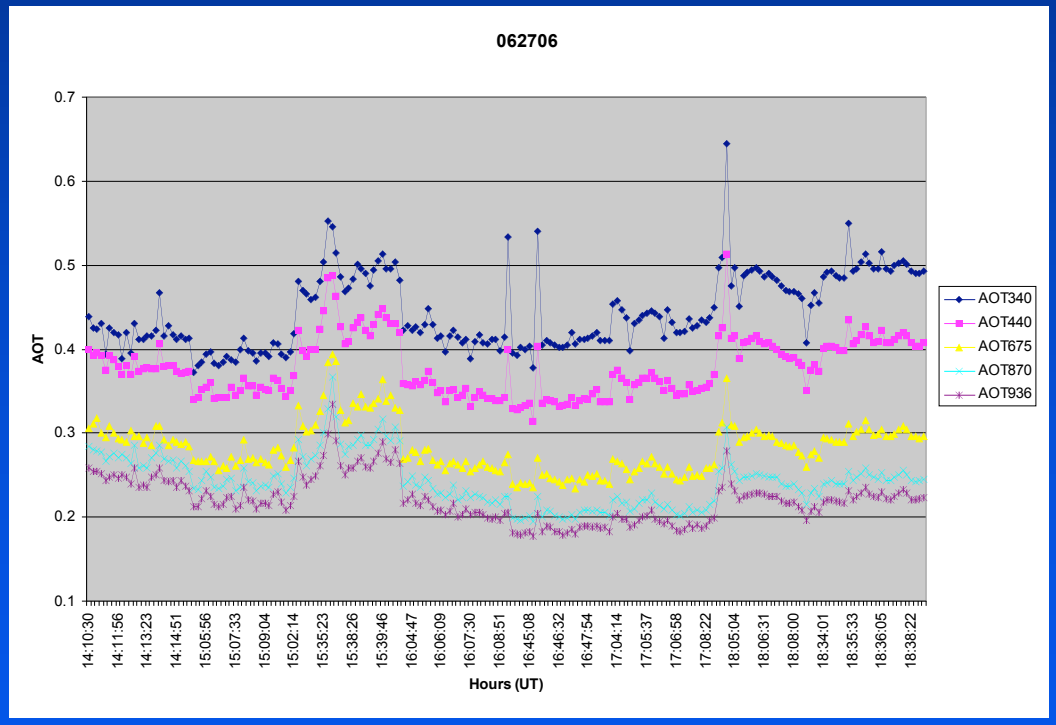




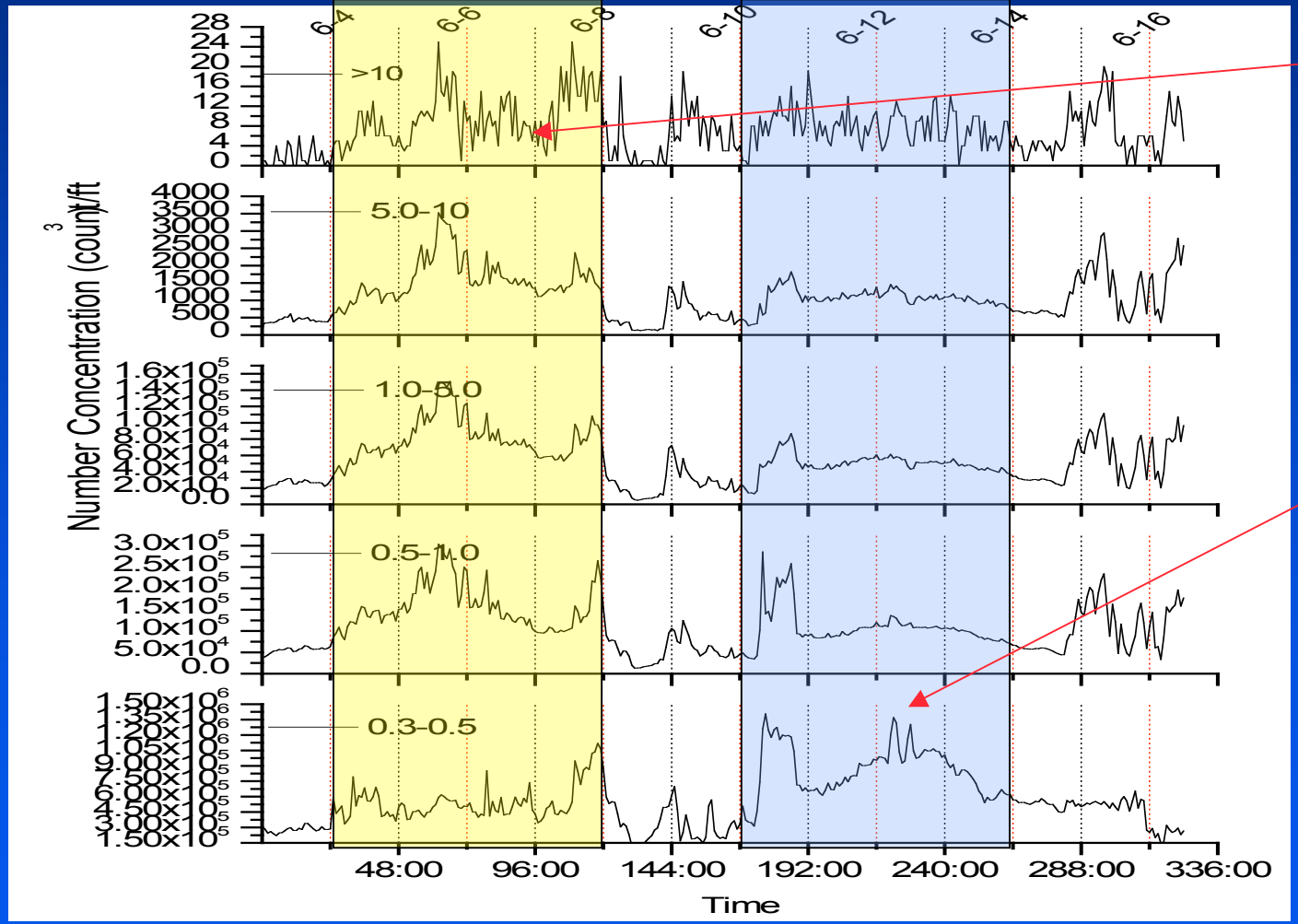
Satellite, NAAPS, and Microtops Aerosols During AEROSE-II Leg 2
27 June 2006 12:00 UTC

Smoke





Leg 1 North-South Transect
Hourly Averaged Number Concentration



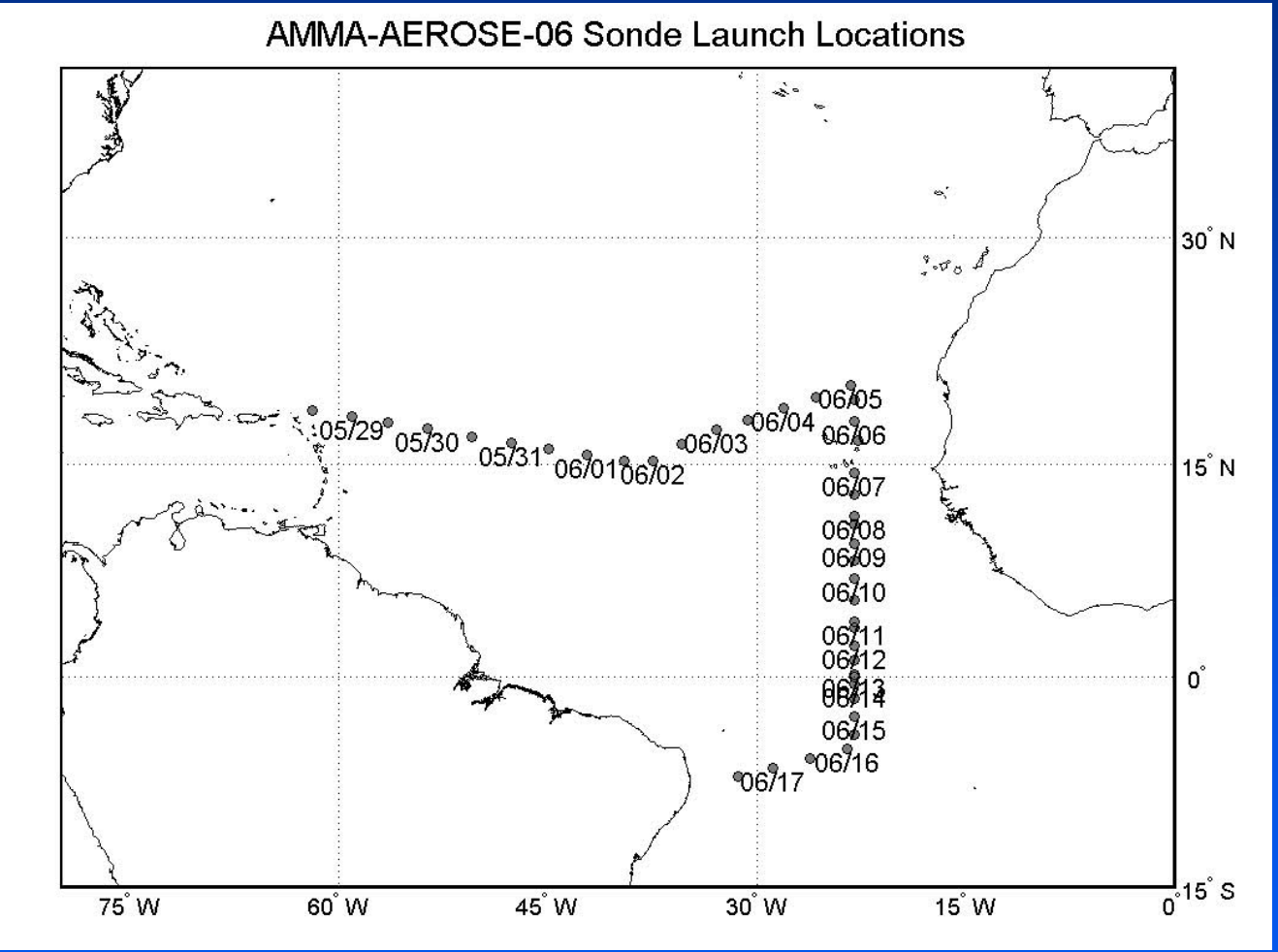
Dust-impacted

Smoke-impacted

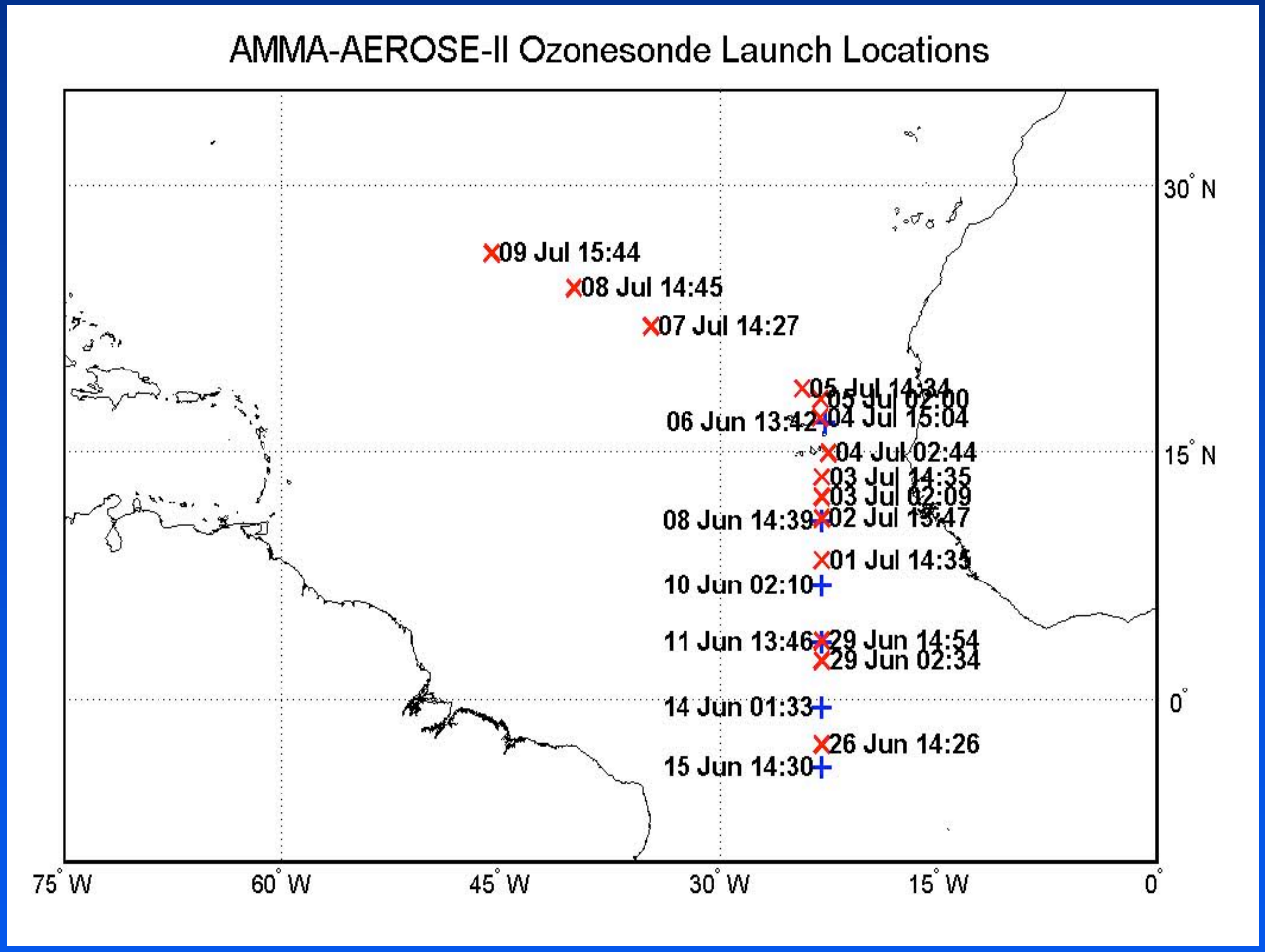
Sondes

- Vaisala RS92 GPS rawinsondes were launched during both legs coinciding with AIRS overpass times
- Ozonesondes were launched within dust and smoke plumes
- An Intensive Observing Period (IOP) during the Leg 2 S-N transect consisted of
  - Sondes 4/day at ~01:30, 07:30, 13:30, 19:30
  - Ozonesondes ~1/day at ~01:30 or 13:30 LST
- Totals of ~90 sondes and 20 ozonesondes were launched over entire cruise

Leg 1 Sonde Launches

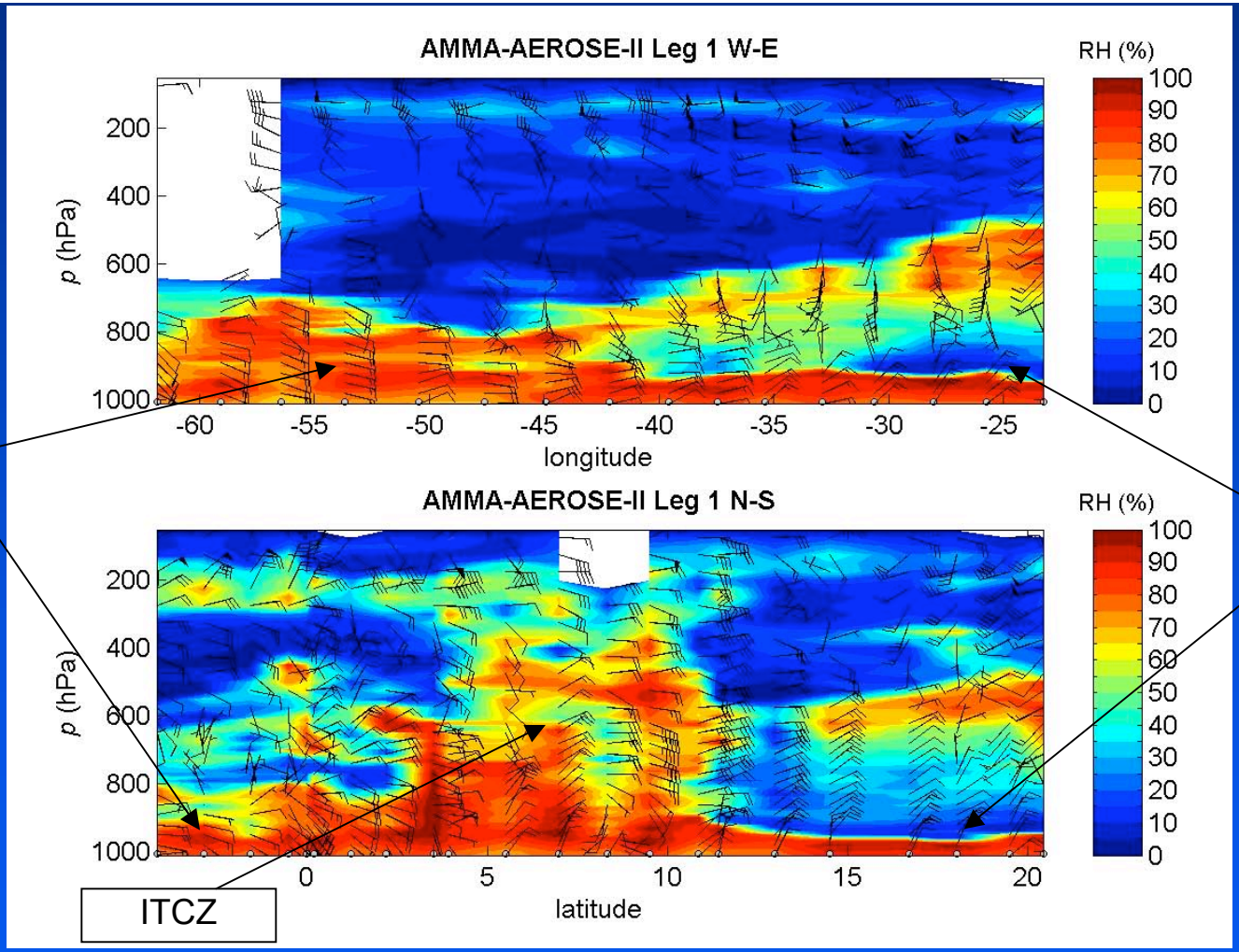


Ozonesonde Launches

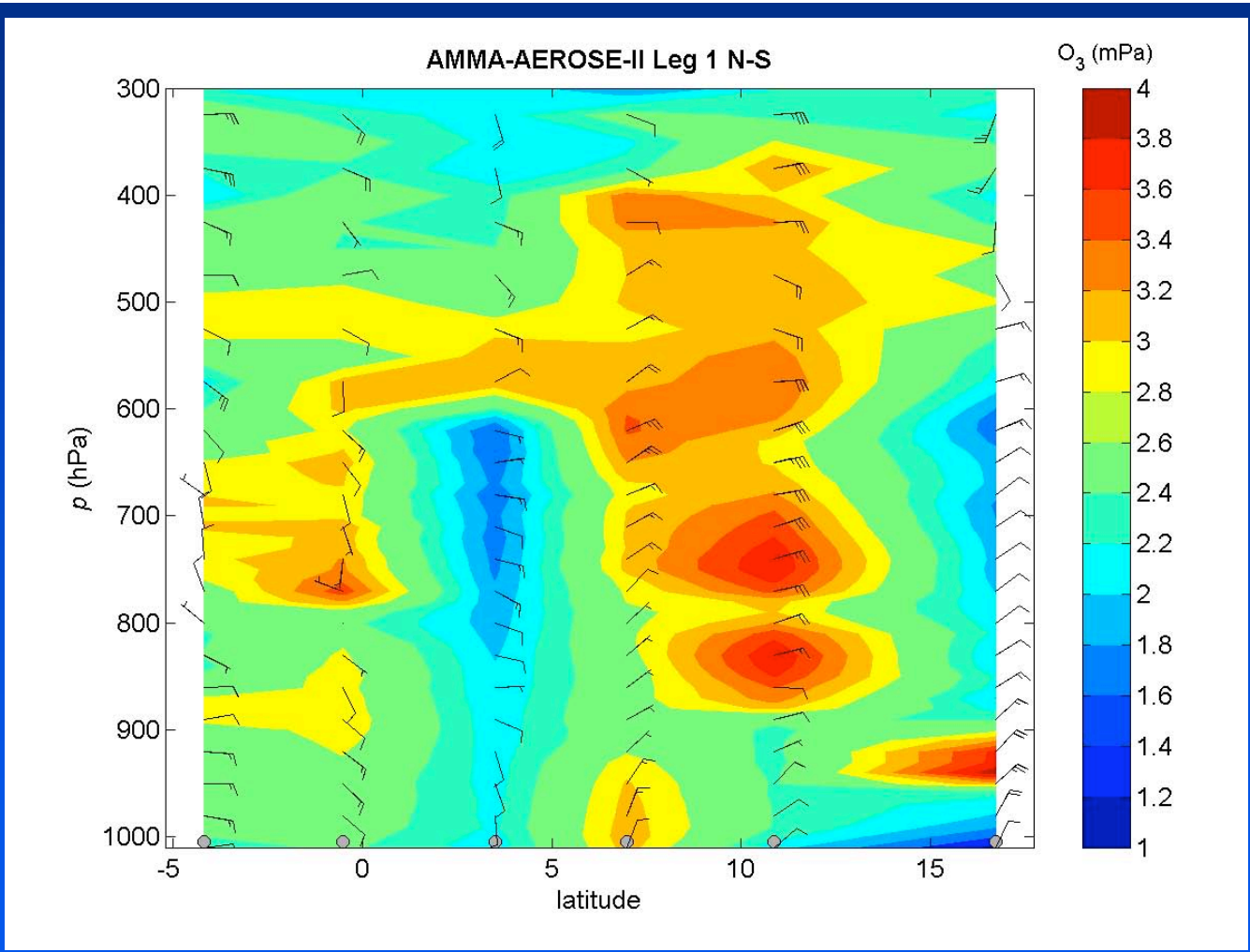


Up, up and away!

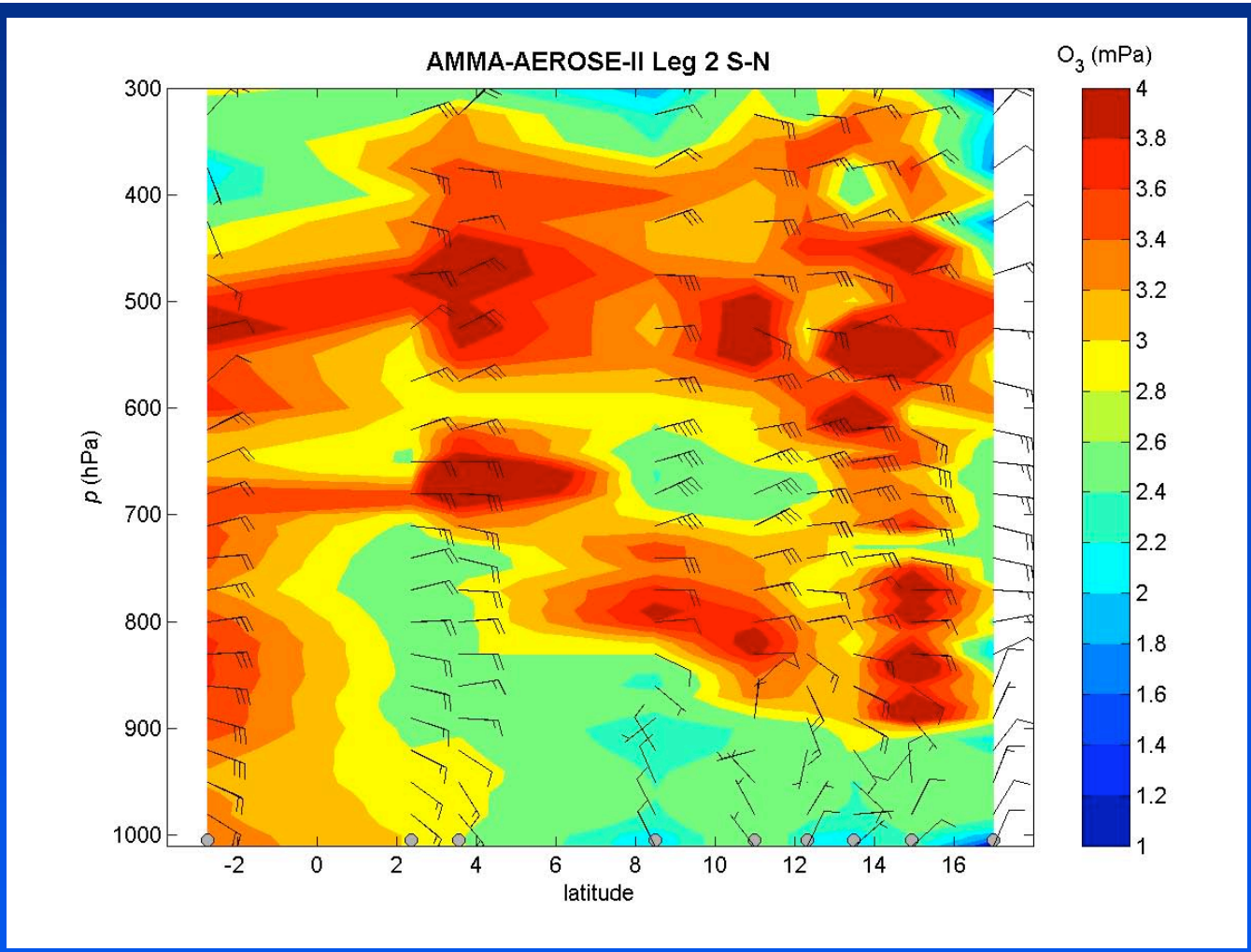
Leg 1 Relative Humidity Cross Sections



Leg 1 Ozone Cross-Section



Leg 2 Ozone Cross-Section



Potential Satellite Validation

- **AIRS** (humidity, ozone, trace gas, temperature soundings; skin SST)
- RTM w/scattering (e.g., surface emissivity/reflection, aerosols)
- AVHRR (SST, clouds, AOD)
- MODIS (aerosol, clouds, Chl-a, SST)
- SAR (winds, ocean features)
- AURA/OMI (ozone profiles)
- TRMM (vertical precipitation profiles)

Summary

- The AEROSE-II piggyback combined atmospheric and oceanographic measurements acquired with a wide number of ship-based *in situ* and remote sensing sensors in an interdisciplinary fashion.
- The cruise domain spanned the north and south tropical Atlantic Ocean, a region of great interest in terms of the SAL, tropical storm formation, and tropospheric ozone/carbon/aerosol chemistry and transport.
- AEROSE intensive campaign data will used for AIRS validation activities in this otherwise challenging region.

Imminent Work

- Ozonesonde and surface ozone comparisons (w/ HU/NCAS)
- AIRS O_3 retrieval marine validation downwind of Saharan dust and biomass burning (w/ J. Wei, E. Maddy)
- Emissivity/reflection model validation (w/ P. Minnett)
- AIRS temperature/H_2O profile validation (w/ UW/CIMSS, UM/RSMAS)
- Aerosol retrievals/kCARTA modeling (w/ S. DeSouza-Machado and L. Strow)

Acknowledgements

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- **National Science Foundation Career Grant** (ATM-9703167)
- **NASA Grant at Howard University** (NG-1224)
- **NASA AQUA Team** (NAG511104)
- **Joint Center for Satellite Data Assimilation (JCSDA)** FY06 Science Development and Implementation Task (JSDI)
- **NASA's Tropical Center for Earth and Space Studies** of the University of Puerto Rico at Mayagüez (NCC5-518)
- We acknowledge the participation and support of all the **AEROSE Science Team members** and the many students who participated in the cruises.
- We also thank the **officers and crew of the *Ronald H. Brown*** for their support during 8 weeks at sea.